REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested.

Upon entry of this amendment, claims 1-87 will remain in the application, with claims 1-7, 16-36, 45-65, and 74-87 being withdrawn.

Claim Rejections - 35 USC § 103

Claims 8-15, 37-44, and 66-73 were rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Yanagihara (U.S. Patent No. 5,374,958) in view of Reininger et al. (U.S. Patent No. 5,426,463, hereinafter "Reininger").

Applicant respectfully traverses the rejections.

Applicant teaches a video compression technique for reducing the level of chroma noise that results from any given value of the quantization parameter (QP) used during compression, thereby improving image quality. This is accomplished by utilizing a lower value of QP for the U (chroma)-channel than for the Y (luminance)-channel. Similarly, the quality of the V (chroma)-channel may also be improved by utilizing a lower QP value for the V-channel than for the Y-channel.

The Action concedes that Yanagihara, "fails to particularly disclose quantizing the color channels with greater resolution than the luminance channel…". The Action then relies on Reininger to provide teaching for utilizing a higher quantization resolution for the color channels than the luminance channel. However, Applicant contends that this characterization of Reininger is incorrect. Reininger discloses a technique in which the same QP is used for both luma and chroma, and there is nothing in Reininger that refers to

different QPs for luma and chroma. Accordingly, Applicant submits that the Action has failed to make a *prima facie* case of obviousness, as discussed in more detail below.

Lossy video codecs use quantization to control the trade-off between visual fidelity and the degree of compression. This trade-off is that the larger the degree of compression, the lower the visual fidelity.

For all codecs of any significance, the degree of quantization is controlled by a *quantization parameter*, QP. QP is simply a parameter from which the *quantization step-size*, QS, is derived. The quantized representation is then just the quotient of the value to be quantized, X, and the quantization step-size QS. That is,

$$\text{Quantized value} = X/QS \qquad (1)$$

This quotient may or may not be rounded.

Often the quantization step-size QS, is the same as the quantization parameter, QP (for example, MPEG-2 with *q_scale_type* = 0). Alternatively, the values of QS may be distributed exponentially (for example, MPEG-2 with *q_scale_type* = 1 or H.264). By convention, a larger value of QP corresponds to (that is, determines) a larger value of QS which results in a coarser quantization which produces fewer coded bits but poorer visual fidelity or quality. Conversely, a smaller value for QP always results in a smaller (finer) quantization step-size, and hence more coded bits and higher visual quality.

The *quantization resolution* is, trivially, the inverse of the quantization step-size QS and hence varies inversely to the quantization parameter QP. Thus the higher the quantization resolution the lower QS (and QP) will be, and vice-versa.

The human visual system is less sensitive to color (or chroma) than luminance (or luma). The perceivable spatial resolution of color is roughly half that of luminance because of

the relative distribution of rods and cones on the retina. This is the justification behind the common 4:2:0 video format in which the spatial resolution of color is half that of luminance in both the horizontal and vertical directions. However, when the displayed resolution (in arc seconds) of the image is not at the limit of luminance resolution, this relationship is no longer true and chroma artifacts become visible. These effects are typically referred to using the term *chroma noise*.

Yanagihara discloses a method that increases the quantization step-size for chroma with respect to the quantization step-size for luma. Any increase in quantization step-size must increase the quantization noise. Thus it is impossible for the method disclosed in Yanagihara to reduce chroma noise because a coarser quantization step-size must increase quantization noise. This basic and well-known behavior is summarized in Table 1. Table 1 compares the effects of increasing versus decreasing the quantization step-size.

Chroma Quantization Step-Size (QS)	Chroma Fidelity	Chroma Noise	Bit Rate
Increasing	Decreasing	Increasing	Decreasing
Decreasing	Increasing	Decreasing	Increasing

Table 1 Increasing versus decreasing quantization step-sizes

It is clear that Yanagihara patent seeks to reduce overall distortion by trading *increased*, as opposed to reduced, chroma noise for better overall image quality by using the bits saved by quantizing chroma more coarsely to quantize luma with a smaller, finer resolution. In other words, Yanagihara trades

increased chroma noise for reduced luma noise. In order for this increased chroma noise to have minimal visible degradation, the Yanagihara method increases the chroma QS relative to the luma QS only for those macroblocks that exhibit high motion as determined by his threshold criteria.

Reininger discloses a method for rate control. The method requires multiple passes. Macroblocks that require more bits than the average plus one standard deviation ("ThV") are recoded using a higher QP iteratively until the bit rate target is achieved. The degree to which the bit rate exceeds its target determines a variable, *xs-frac*. The combination of the old QP and *xs-frac* are used to index one of three tables (Figs. 4, 5, and 6 - depending upon whether the macroblock type is I, P, or B) that determine the new QP for that macroblock. This updated QP is stored in a memory ("q MEM" in Fig. 2 as well as "WORKING QUANTIZATION MEMORY" in Fig. 7). Then the macroblock is recoded with this new QP and unless the target bit rate for that macroblock is achieved, the entire process is repeated.

However, Reininger always uses just one QP for both luma and chroma. Without separate QPs for luma and chroma, this reference is not relevant.

Consider exemplary independent claim 8 in the present application, which recites in relevant part:

"...utilizing a first QP value for the Y luminance channel of a color video image; and

utilizing a second QP value for at least one of the U and V color channels of the color video image, wherein the second QP value is less than the first QP value, so that said at least one of the U and V color channels has finer quantization resolution than the luminance channel."

Neither Yanagihara nor Reininger, either alone or in combination, teaches or suggests a method for *reducing chroma noise* utilizing a smaller QP value for one or both of the color

channels than used in the luminance channel to provide a finer quantization resolution in the color channel(s) than the luminance channel. Accordingly, Applicant submits that the Action has failed to make a *prima facie* case of obviousness, and accordingly claims 8-15, 37-44, and 66-73 are allowable.

Please apply any charges or credits to deposit account 06-1050.

Respectfully submitted,

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